

Simulations And Training:

Integrating Constructive, Virtual, And Live Simulations Into Unit Training Programs

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"Therefore it is said that one may know how to win but cannot necessarily do so" ...Sun Tzu.

The old saying is "Live and learn." We must reverse this in war to "Learn and live." We have the technology to train — defined at task level, in constructive, virtual, and live environments — the full capability and synergy of our combat systems, battle-focused for the full continuum of warfighting.

Technology enables the solution — a trained and ready Army with precision in thinking, planning, and execution.

Computer simulations are growing in importance as training devices because they add realism to training and potentially reduce training-related costs. Training devices range from the inexpensive, such as terrain boards, to technical, multimillion-dollar, computer-driven simulators and systems. Simulations are important tools used in training and testing. In the 1970s, war games were converted into two-dimensional computer applications that played in real time, allowing battalion, brigade, and corps staffs to conduct exercises. In the 1980s, technological advances provided the capability to network multiple, similar, weapon system simulators into an interactive, electronic battlefield where military crews conducted realistic, task-based training. The primary example for maneuver units is Simulation Networking (SIMNET). SIMNET initially allowed for force-on-force free play and more recently, structured, task-based training. In the late 1990s, the Close Combat Tactical Trainer (CCTT) will replace SIMNET, and the groundwork for joint exercises and training with allied and coalition forces is under development.

Computer simulations provide important training opportunities and capabilities not always feasible or affordable in field training exercises. Large-scale field exercises that emphasize battle planning

and command and control of forces are costly, require a sizable maneuver area, are time-consuming, and cause significant downtime for lower echelon personnel. Training in simulations provide opportunities for individuals and units to practice techniques and procedures, improving proficiency in required skills, both before and after participating in field exercises. The loss of resources or maneuver constraints should not lead one to the conclusion that (virtual/constructive) simulations are a "one-for-one" replacement training tool for those lost resources. Virtual and constructive simulations are not designed for the validation of mission essential task list (METL) tasks. As a result, this powerful capability presents a leadership challenge for leaders and units to determine the proper use of training simulation devices and systems within available resources.

The real art in determining the proper use of available simulations is to understand what tasks can be trained by the different types of simulation. One must also understand how well those tasks can be trained, by whom, and at what level. The purpose of this article is to provide some insight on the capabilities of current simulations and how to optimize a unit's training program using simulations.

The first step in understanding how to incorporate simulations into a unit training program is to understand the definition of each type of simulation: constructive, virtual, and live. Constructive simulations are identified with complex, computer-driven models most often associated with exercises dealing with battalions, brigades, divisions, and corps. The primary training audience of constructive simulations is the commander, subordinate commanders, and battle staffs associated with that echelon of command. Virtual simulations are designed to train individual soldiers and crews in collective training tasks. Virtual simulations

are often associated with crew-served weapons systems and focus on training devoted to emphasizing familiarity, skill development, and practice. These simulations contain simulators that closely replicate all or parts of tanks, armored personnel carriers, and other equipment. Virtual simulations normally require the training unit to immerse itself into the simulated battlefield. Live simulations are training events where all the soldiers, leaders, units, and staffs physically deploy (usually against an OPFOR) and use (weapons) simulators to replicate certain parts of combat. Live simulations take place almost anywhere the maneuver space is available (home station, combat training centers).

As resources dwindle, there is increasing recognition that, while traditional field (live) training exercises are the preferred method of training, and essential for validation of critical METL tasks, they can have significant limitations and are often cost-prohibitive. In some cases, these limitations can be overcome or minimized through the use of simulations. For example, gunnery and field maneuver can be limited by the high cost of fuel, training ammunition, and repair parts; lack of space; safety and environmental concerns, as well as a lack of time required to prepare for and undertake such exercises. Simulations are available to assist a unit in refining skills needed to effectively and efficiently conduct those valuable but costly exercises.

Several factors influence the trend toward increased use of constructive and virtual simulations, including safety, reduced costs, environmental protection, land use restrictions, and training scenario flexibility (exercises can be quickly reset, and the factors of METT-T modified as required). Simulations are a tool to maximize training opportunities, especially when resources are limited. Training using simulations can prepare a unit to get the maximum benefits from scheduled field training exercises by providing a flexible training system to the unit before deployment, and as a sustainment and integration training tool. Therefore, simulations should be considered and incorporated into your overall training strategy at all levels, regardless of resource limitations.

The Army, in formal training field manuals, does not currently prescribe

simulations as required training devices because they are not available to all units. Additionally, there are a limited number of tested, standardized training exercises and structured training, or Training Support Packages (TSPs), available for units to prepare training. Therefore, units must develop their own training, sometimes without the benefit of proven methods, to optimize the benefits of the simulation.

Virtual and constructive simulations used in training depict the essence or effect of live exercises (tasks, conditions, and standards) by providing cues/responses that cause the training unit to perform the skills used and those skills that are transferable to a live training environment (live simulation). The training outcomes and behaviors accurately reflect the training outcomes that would have resulted from a similar live simulation exercise. A critical advantage in simulation training is the ability to use prepared exercises that control conditions and cues to ensure that the desired training outcome is achieved, and to provide the ability to record and play back the events exactly as they occurred. There are several ways in which training devices and simulations can support the performance measures of a given training exercise. The range of compatibility goes from those tasks that cannot be supported in simulation, a reminder that validation of METL tasks must be done in a live simulation training environment, to tasks that are highly supported by a simulation (virtual/constructive) environment where the training experience is “*much the same*” as a field environment (live simulation).

The supportability of a task trained in a given simulation depends on whether the cues and responses available result in positive or negative training. A cue in simulation is the stimulus (visual or audio) that causes the unit to make a decision and execute a task. For example, an enemy tank fires on the unit, causing an action on contact or a FRAGO issued by the next higher headquarters. Sufficient cues for the tasks being trained in a structured training environment are provided to allow the participants to practice tactics and techniques and sustain those skills that are transferable to a live training environment. Most simulations focus on C2, maneuver, fire control and distribution, and teamwork. In other cases, sufficient cues or responses are not available, and the execution of certain tasks result in a negative training experience. An example of a negative training experience would be when the simulation causes the user to learn a task

incorrectly. For example, SIMNET could drive the tank at an unrealistic speed without regard to the effects of terrain, causing the driver to employ unsafe driving habits.

The Army has the capability to replicate tactical engagements through constructive, virtual, and live simulations, known together as the Simulation Toolbox. Before employing the proper simulation, the commander and his staff must ask and answer these four questions.

- Who is being trained? Who is the target audience?
- What tasks are being trained? What are the terminal learning objectives (commander's intent)?
- What resources are available? (time, OPTEMPO, ranges, CTCs, simulation devices)
- What is the best environment to use, constructive, virtual, or live?

Answering these four questions assists the trainer in choosing the proper simulation. Several simulation methods can be employed to meet overall training objectives. Each simulation performs specific tasks for the trainer. Selection of the proper simulation, or simulations, ensures that tasks are trained to sustain and training outcomes are present. Figure 1 provides a brief description of several methods and devices. This is not an all-inclusive list but provides some information to help the trainer select the appropriate method of simulation to meet the unit's training objectives.

Training Strategy Development

Several factors influence the development of a unit's training strategy and the simulations used to support that strategy including: current doctrine, the unit's METL/METT-T, and results of training needs assessments.

The Army's primary training publications (*FMs 25-100* and *25-101*, along with *TRADOC REG 350-70*) contain training methods that are relevant to training in virtual, constructive, and live environments. The following list of principles can assist you in developing a training strategy incorporating simulations: (*ST 17-12-7-3-1*, p. 10)

- Make commanders the primary trainer
- Train as you fight
- Train to maintain
- Train as combined arms and services teams
- Use performance-oriented, structured training
- Use appropriate doctrine
- Train to sustain proficiency
- Train using multi-echelon techniques

After the unit has determined its mission from its METL, conducted a training needs assessment, and determined training needs, it must select a simulation to best fit the unit's requirements. The manner in which simulations are incorporated into your training program is a “green tab” issue with staff input. Generally, simulation exercises should be conducted quarterly at the brigade level

Training Device	Training Environment	Target Audience	Purpose
Conduct of Fire Trainer (COFT)	Virtual	Tank Cdr/ Gunner Team	Train/sustain precision/ degraded gunnery skills.
Platoon Gunnery Trainer (PGT) (M1A1) & Advanced Gunnery Training System (AGTS) M1A2	Virtual	Tank Cdr/ Gunnery Team/ Plt Leader	Train/sustain platoon of TC/gunner teams on fire coordination, distribution, platoon coordination & precision/degraded gunnery.
Tank Weapons Gunnery Simulation System/Precision Gunnery System (TWGSS/PGS)	Live	TC/Gunner	Train/sustain precision/degraded gunnery skills.
Tank Driver Trainer (TDT) Janus	Virtual Constructive	Driver Plt & Co Cdrs/ Bn & Bde Staffs	Train/sustain M1-series driver Trains command and control, synchronization, and decision-making processes.
Brigade/Battalion Simulation (BBS)	Constructive	Bde/Bn Cdrs & Staffs	Trains commanders and staffs in decision-making processes.
Simulation Networking (SIMNET)/Close Combat Tactical Trainer (CCTT)	Virtual	Platoon thru Battalion	Trains/sustains collective tasks from crew thru battalion level.

Figure 1: Selecting the Appropriate Simulation (Quick Reference)

and below. However, the number, type, and frequency of occurrence depends on the METT-T factors (based on personnel turbulence and skill fade) at each location. Additionally, the commander is responsible for determining the proficiency of the unit in each task on the METL. He has the responsibility of conducting training IAW ARTEP and MTP standards by which performance is uniformly measured. Simulations cannot give you an objective assessment of the unit's proficiency in METL tasks.

When selecting simulations, choose the one that provides the most benefit in achieving and maintaining task performance. Therefore, do not select a simulation if a more appropriate training method is available. The key to choosing the proper simulation is understanding that simulations do not equal live training, nor do they train every task well in every situation. Simulations are training aids that allow the training unit to practice skills and tasks in a scenario specifically designed to present and observe those tasks. Placing the simulation training experience into the overall development of the unit provides invaluable assistance. The Combined Arms Training Strategy (CATS) developed at Ft. Knox is designed to help manage training resources in an integrated manner and to assist units in determining the proper "mix" of simulations in training. CATS establishes a definitive relationship between the mix of field and "simulation tool box training" by showing the training events to be conducted, a more detailed description of the available simulations and training devices, and the resources needed to conduct those training events. The following portion of this article explains in more detail the different aspects of the "simulation tool box" — constructive, virtual and live.

Constructive Simulations

In the majority of cases, these simulations are exercise drivers for CP-type training exercises where the commander and staff are in field CPs. The adjacent, higher, and lower units are "played" in computer workstations transparent to the primary training audience. Communication between the commander and workstation units is with organic communications (some locations have internal TOC facilities where communications are replicated by CB radios).

An example of a constructive simulation where the training audience does not personally or physically interact with the simulation is the BBS (Brigade and Battalion Simulation). BBS is designed as a low-cost training simulation. BBS

provides maneuver brigade and battalion commanders and their battle staffs the opportunity to practice decision-making skills. BBS focuses on the execution of Army doctrine in a realistic, multi-threat, time-stressed combat environment. The commanders, with their battle staffs, must be able to develop, correlate, and assess large quantities of tactical and logistical data. They must formulate situational estimates, and make immediate decisions in the C2 and synchronization of combat, CS, CSS, and aviation assets. BBS supports training of combat maneuver commanders and the staffs at brigade and battalion levels (BBS focuses heavily on combat support and combat service support). Company commanders, CS, and CSS units (role players) also receive valuable secondary training as part of any BBS-driven CPX. Normal training time for workstation interactors and warfighters is 6-8 hours. BBS is a personnel-intensive simulation; for example, a battalion-level exercise requires approximately 21 personnel (minus the staff sections that would be located in the TOC and CTCP) to serve as the maneuver elements and role players. A company exercise would take approximately 10 personnel (minus site staff).

Although primary training audiences do not come in direct physical contact with most constructive simulations, some of these simulations require direct interaction with the training unit. This is the case with the Janus simulation. Janus is an interactive, event-driven wargaming simulation used to train platoon leaders through brigade-level commanders and their staffs. Training specifically focuses on the application of tactical doctrine and combat techniques. Janus focuses primarily on ground combat operations and the synchronization of direct and indirect fires. Players must consider all aspects of employing their forces, just as they would in combat. Janus accurately models both friendly and enemy weapons systems with resolution down to the individual platform (e.g., T-80, M2, or individual soldier weapons).

These systems have distinctive properties, such as dimension, weight, carrying capacity, weapons, and weapons capabilities; all of which can be affected by terrain and weather. Recent enhancements include, as one example, the ability to conduct military operations in urban terrain (MOUT) and improved dismounted infantry functionality, as well as multi-sided, coalition-type operations, including non-combatants.

At the battalion and brigade level, Janus serves as an excellent training simulation requiring detailed com-

mander-S2/S3 interaction as they develop and execute the ground tactical plan. Commanders must apply sound warfighting principles and achieve full synchronization of the BOS to fight a successful Janus battle. Normal training time for workstation interactors and warfighters is 8-12 hours. Janus is a less personnel-intensive exercise than BBS. Approximately 12 personnel (minus the staff) are needed to conduct a battalion exercise. A company requires approximately 6 personnel.

Outcomes from constructive simulations are based on models of attrition and algorithms within the simulation. Most constructive simulations require interactive free-play from the workstation role-players in both friendly and opposing forces. Janus is used effectively to train ground combat operations and the synchronization of direct and indirect fires, while BBS is effectively used to train battalion staff and higher level staffs while focusing on combat support and combat service support tasks. Regardless of which specific constructive simulation is used, all are efficient in training leaders and staffs from platoon through brigade.

Virtual Simulations

As previously stated, virtual simulations normally require the trainee(s) to be immersed in the simulated battlefield. The soldier, leader, staff, or unit then inputs the applicable information into the controls of the simulator. Visual, sound, and motion playback cause the trainee to continue interacting with the simulator through a prescribed number of tasks.

Virtual simulations are referred to as simulators because they are either a single part (SIMNET) or complete replicas (CCTT) of individual or crew-served weapon systems and/or vehicles. SIMNET exploits the ability of computer technology to transfer data streams across networks containing large numbers of simulators with real-time update of simulators in the network. SIMNET trains combat units at the crew through battalion echelons. Existing simulators are in the form of M1 tanks and infantry fighting vehicles. Emulations of field and air defense artillery, engineer, dismounted infantry, and combat service support also exist through the use of Automated and Semi Automated Forces (SAF). The planned follow-on system is the CCTT. The CCTT projected fielding date is FY98.

Virtual simulations are designed to provide primary training to individuals and crews in collective training. Major func-

tions of the CCTT include: improved vehicle and graphic fidelity, out-of-the-hatch view capability, and increased weather functions. Scenarios suited for simulation (constructive and virtual) have been developed to provide a "nested" environment that facilitates concurrent, multi-echelon training for units in both the constructive and virtual environment. This program is currently being executed at Ft. Knox, Kentucky, and is referred to as the Virtual Training Program (VTP).

The VTP is a structured training program designed to specifically improve the readiness of mechanized brigades through the use of virtual and constructive simulations. They are used in conjunction with structured training support packages to provide the ability to train specified tasks in a "matrix type" format. These structured training support packages include pre-developed operations orders, graphics, and tables that expose the training unit to a specified set of tasks, conditions, and standards developed from Army mission training plans. This format allows units to progress from simple to complex tasks. The hardware and software used by the VTP, along with a professional observer/controller team (battalion and brigade level) provides a state-of-the-art after-action review during their training rotation. The OCWS (Observer Controller Work Station) used in virtual simulation includes playback of the battle (two- and three-dimensional view), complete with audio cuts of communication, at any speed, any time desired, and from a 360-degree point of view. The constructive simulation center provides a Janus Army Analysis Workstation (JAAWS) playback of the battle exactly as it was executed, complete with charts and graphs with supporting statistical information. In addition, a comprehensive take-home packet is mailed to the training unit to provide assistance in developing home station training programs.

Live Simulations: "The Preferred Method of Training"

As training dollars are reduced and live training opportunities are being limited, the use of simulations as a part of a unit training program is critical to unit readiness. If used properly, simulations can sharpen those "transferable skills" necessary for successful execution and reduce the actual training time needed to conduct a validation of a unit's METL-based Training Plan.

The most notable formal training in the Army utilizing live simulations are the

Combat Training Centers — The National Training Center (NTC), the Joint Readiness Training Center (JRTC), and the Combat Maneuver Training Center (CMTTC). In each of these CTCs, troops conduct tactical operations as units and utilize various simulations and simulation devices in the course of training.

Some of the simulation devices used are MILES and SAWE-RF, which replicate weapons systems interaction and damage resulting when these simulators are employed. In live simulations at the combat training centers, much of the battlefield is instrumented. The instrumentation devices provide the opportunity for units to train in a force-on-force environment. By using electronic instrumentation devices on tactical vehicles, the training, analysis, and feedback center collects data for the creation, execution, and support of the after-action review process. Since live simulations are associated with force-on-force training exercises, the emphasis on training is on individual and collective training. Residual and secondary learning occurs for the leaders, as well as enhancing the unit's C2 processes, an area that can be trained heavily in all types of virtual and constructive simulations.

Simulations provide a combat rehearsal system for AC/RC units to plan and train for contingency missions using simulations for operations at battalion through echelons above corps, including joint and allies.

Using simulations, we can go from "I hear and I forget, I see and I remember, I do and I learn" (Confucius, 500 B.C.) to "I see, I do, and I learn" (Director, NASA Ames Laboratories).

Warfighting today is dynamic, multi-dimensional, multifaceted, and constantly evolving — it's akin to managing chaos. Diplomacy, cultural/ethnic/religious connotations, environmental impacts, just to name a few, preclude treating any contingency as business as usual, or gaining a situation snapshot. Timelines for mission rehearsal have shortened. Shortened timelines make C2 and information systems integration and fusion critical. In current and future training, our goals should be geared toward harnessing and exploiting that information through training with simulations. Future training in simulation will move toward exercises routinely combining virtual, constructive, and live simulations with instrumentation. When these three tools are linked in the same exercise, commanders could train (constructive) with crews (virtual), operating on the "terrain" of the commander's situation map, while individu-

als and crews (live) actually conduct force-on-force operations on the terrain represented on the commander's map. Combining constructive, virtual, and live simulations could have a number of training advantages as they, in combination, create a synthetic, seamless environment of warfare.

While we are now armed with a better understanding of the powerful possibilities of training with simulations and their capabilities, several questions still remain. How are we going to be able to prepare our soldiers, leaders, staffs, and units for contingencies in areas we have never been before to execute missions across the operational continuum? Given a generic METL and no METT-T until the mission order is issued, how do leaders and staffs select courses of action, validate their operational METL with METT-T defined? Given the ability to rapidly produce digital terrain databases, the answer will certainly include simulation as a way to preview the terrain and infrastructure in developing various courses of action, which can be evaluated, stored, and repeated prior to selection and execution in response to the contingency.

Given the short amount of time available to train, selecting the appropriate course-of-action, force structure, and timeline is critical to battle-focusing the unit's training prior to deployment. Given the appropriate fidelity, a terrain database could provide sufficient rehearsal opportunities for a unit. Therefore, when the unit is deployed, they arrive with the feeling that they have been there before — an excellent morale builder where the commander's intent is understood and the boldness of warfighting can be confidently executed with precision. A deliberate end-state could be defined and visualized from the assembly area to the objective, with a shared view of the end-state desired prior to execution: a way to see the "setting of conditions for battle" and adjusting those conditions to maximize a unit's lethality.

All of these aspects should be considered as we continue to develop training simulations and include those simulations in our training programs. Understanding the capabilities and limitations of the simulations and training resources available will help the unit to choose the correct simulation to maximize training. Simulation training devices are an excellent sustainment and integration tool with enhanced capabilities designed to sharpen unit skills and make the maximum benefit of the unit's live training program. *"These are hard times in which a genius would wish to live. Great ne-*

cessities call forth great leadership"...(Leaders)

References

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Bennis, Warren and Bert Nanus, *Leaders: The Strategy of Taking Charge*. Harper and Row Publishers, New York, 1985.

To find more information about the CATS Strategy (produced by the Training Development Division, Directorate of Training and Doctrine Development, Ft. Knox, Ky.), call Mr. Mike Kelley @ DSN 464-2505 or commercial at 502-624-2505.

ST 17-12-7-3-1, *The Battalion Commander's Training Handbook*; May 97, (produced by the Training Development Division, Directorate of Training and Doctrine Development, Ft. Knox, Ky.) - call Mr. Mike Kelley @ DSN 464-2505 or commercial at 502-624-2505.

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